

the Southwest on the 14th and moved northeastward over the upper Lake region, the center reaching the Lakes on the 15th. General warnings were displayed on both these dates.

The regular storm warning season terminated December 16, but advisory messages have been sent since that date to open ports on Lake Michigan in advance of threatening conditions.

The storm warning service rendered by the Weather Bureau during the season just passed has been very acceptable to all Lake marine interests, and practically no disasters through stress of weather overtook vessels that took advantage of the storm warnings and advisory messages. The Lake Marine News Bulletin on December 16 states as follows:

Captains give the Weather Bureau high praise for the excellence of its storm signals throughout the fall. Except the *Bannockburn*, nearly all the ships lost by foundering or stranding were well along in years, and some of them doubtless not well equipped to meet storms.

No exceptionally severe cold waves crossed over the district during the month, but the most marked condition was that which moved in from the Northwest on the 6th and 7th. Cold-wave warnings were issued for the entire district on the 6th. Warnings were again issued on the 23d and 24th and transportation companies notified.—*H. J. Cor, Professor of Meteorology.*

#### DENVER FORECAST DISTRICT.

On the morning of the 14th warning of a cold wave was sent to points in western Colorado and northern New Mexico; this warning was fully verified over nearly the entire area. The snowstorm of the 19th in eastern Wyoming and northeastern Colorado, which was forecast, was the feature of the month. The attending high winds were not felt in central Colorado, but in southeastern Wyoming and the extreme northern and northeastern portions of Colorado the high velocities caused the wind to drift the snow badly, and on some railroad lines traffic was suspended three or four days. Fortunately for live stock interests, no very low temperatures attended the storm.—*F. H. Brandenburg, Forecast Official.*

#### SAN FRANCISCO FORECAST DISTRICT.

The month was on the whole rather free from severe storms. Less rain than usual fell, and with the exception of the storm in southern California of the 16-17th the damage was slight. The most interesting feature of the month was the daily receipt of a weather message from the Pacific Ocean, through the courtesy of the Commercial Cable Company, from the cable ship *Silverton*, engaged in laying cable to Honolulu.

Southeast storm warnings were displayed on the 3d from Point Reyes to Eureka, and incoming vessels reported high southeast winds off shore.

Southeast storm warnings were displayed from San Francisco to Eureka on the 8th, and advisory messages were sent to southern ports. In the vicinity of Point Reyes a maximum wind velocity of 54 miles an hour from the south occurred on the 9th.

Heavy rains occurred in central California on the 11th. Heavy frost occurred at many points on the 14th and 15th.

The first report from the cable ship *Silverton*, when about 90 miles off shore, was received on the 15th. An interesting fact is that the steamer then experienced strong southeast wind and rain, and twenty-four hours later, when nearly 300 miles southwest of San Francisco, the wind had changed to strong northwest with confused, heavy sea. The steamer appears to have run through the northern end of the disturbance which reached the coast of southern California on December 16. Unusually heavy rains occurred on the 17th from Point Conception southward. The *Silverton*, then about 500 miles southwest of San Francisco, reported terrific seas all

during the night of the 16th, with a heavy swell on the 17th and indications of better weather. The forecasts of rain for southern California for this period were verified. The winds recorded at Los Angeles and San Diego during this period do not indicate any marked disturbance in their vicinity, yet press dispatches would indicate that considerable damage was done near Terminal Island. The Pacific Mail steamer *Barracouta* reports that on the 17th, 20 miles off Point Conception, a severe storm was encountered, high waves sweeping clear over the vessel. At both observations on the 17th the wind at San Louis Obispo was reported as light from the west. The last decade of the month was marked by numerous frosts. Ample warnings were given and it is believed that but little injury resulted.—*A. G. McAdie, Professor.*

#### PORTLAND, OREG., FORECAST DISTRICT.

The month was wetter than usual in the western half of the North Pacific States, while east of the Cascades the precipitation averaged slightly below normal. Several storms of unusual severity passed over the district, for which warnings were ordered well in advance.—*E. A. Beals, Forecast Official.*

#### AREAS OF HIGH AND LOW PRESSURE.

Movements of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocity.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long. W.	Length.	Duration.	Daily.	Hourly.
<b>High areas.</b>										
I.....	2, a.m..	43	123	4, a.m..	40	97	1,625	2.0	812	38.8
II.....	2, p.m..	58	105	7, a.m..	45	67	1,000	1.5	667	27.8
III.....	4, p.m..	27	97	10, p.m..	32	65	2,150	2.5	860	35.8
IV.....	6, p.m..	54	114	13, a.m..	48	68	3,000	4.0	750	31.2
V.....	10, a.m..	58	109	16, a.m..	46	60	1,950	3.0	650	27.1
VI.....	12, a.m..	50	100	20, a.m..	32	65	2,400	4.0	600	25.0
VII.....	13, p.m..	50	120	24, p.m..	48	68	4,300	6.5	662	27.6
VIII.....	20, p.m..	54	114	29, a.m..	32	65	2,800	4.0	700	29.2
IX.....	24, p.m..	58	105	31, p.m..	40	75	3,000	4.5	667	27.8
	27, p.m..	41	114				3,250	4.0	812	33.8
Sums.....							25,475	36.0	7,180	299.1
Mean of 10 paths.....							2,548		718	29.9
Mean of 36.0 days.....									708	29.5
<b>Low areas.</b>										
I.....	30, p.m..	48	125	4, a.m..	45	64	3,800	3.5	1,086	45.2
II.....	3, a.m..	30	95	5, p.m..	46	60	2,225	2.5	890	37.1
III.....	3, p.m..	51	120	5, p.m..	45	93	1,675	2.0	838	34.9
IV.....	10, p.m..	43	123	14, a.m..	32	65	3,550	3.5	1,014	42.2
V.....	13, a.m..	33	115	17, p.m..	48	68	3,450	4.5	767	32.0
VI.....	18, p.m..	35	106	22, a.m..	48	68	2,325	3.5	664	27.7
VII.....	22, a.m..	52	121	28, a.m..	46	60	3,650	6.0	608	25.3
VIII.....	26, a.m..	51	120	29, p.m..	48	86	1,625	3.5	464	19.3
IX.....	27, a.m..	41	105	29, a.m..	32	88	1,500	2.0	750	31.2
Sums.....							23,800	31.0	7,081	294.9
Mean of 9 paths.....							2,633		787	32.8
Mean of 31.0 days.....									768	32.0

\* November.

For graphic presentation of the movements of these highs and lows see Charts I and II.—*Geo. E. Hunt, Chief Clerk, Forecast Division.*

#### RIVERS AND FLOODS.

The Mississippi River at St. Paul, Minn., was closed by ice on the 3d, and at the close of the month it was blocked to within a short distance of Davenport, Iowa.

At the close of the corresponding month of 1901 the river was frozen nearly 200 miles farther south to Hannibal, Mo., and from the 19th to the 26th, inclusive, was practically blocked from Chester, Ill., to Cairo, Ill.

Heavy floating ice at Keokuk, Iowa, on the 8th terminated navigation for the season in that vicinity, while from St. Louis,

Mo., to Cairo, it became so heavy from the 27th to the 31st, inclusive, that it seriously interfered with, but not entirely ended, steamboat traffic.

No ice was observed below New Madrid, Mo., 70 miles below Cairo.

The Missouri River closed at Pierre, S. Dak., on the 4th, and at the end of the month the ice was 15 inches in thickness.

It closed at Omaha, Nebr., on the same date, nine days earlier than in December, 1901. In that portion of the river within the State of Missouri the ice was somewhat later. Navigation at Hermann, Mo., was not suspended until the 26th, whereas in December, 1901, the river at that place was closed on the 19th.

The James River, Dakota, was closed during the entire month, while the Red River of the North, at Moorhead, Minn., was three days later in freezing from bank to bank. At the close of the month there were 18 inches of ice at Moorhead.

Ice was reported in the Ohio River as far as Portsmouth, Ohio, but there was none of consequence in the tributaries, except the Allegheny and those within the State of Ohio.

The rivers of Maine and the Merrimac and upper Connecticut closed for the season from the 5th to the 8th, and the ice at Concord, N. H., on the Merrimac River, was 7 inches in thickness on the last day of the month.

Navigation on the Hudson River was suspended on the 8th, when the last through boat arrived at Albany, N. Y. Timely notice had been given that navigation would have to be suspended on that date. A gorge formed on the 18th at the Bath Pumping Station, just above Albany. Rain caused a breakup on the 21st, but as the ice passed down the river it again became jammed at the freight bridge at Albany, the jam extending to the bottom of the river. Various other gorges formed later in the month, but were devoid of unusual features.

There was plenty of ice in both branches of the Susquehanna River, but very little gorging or solid freezing as far as reported.

Some little ice was also noted in the Shenandoah and upper Potomac rivers.

The flood in the Red River continued during the month. The report on this flood will be published in the Annual Sum-

mary for 1902, lack of space preventing its appearance in this edition of the REVIEW.

The unusually heavy precipitation for the month also caused comparatively high water stages in the Ohio River, lower Mississippi, and the rivers of the Middle and South Atlantic States. At Cincinnati a flood tide from the Licking River caused a local rise of 12 feet from the 15th to the 16th, and a fleet of coal boats and barges was swept away, entailing a loss of \$25,000. Warning had been given of the coming of this flood wave, for such it was, but the damage could not be prevented.

The Kentucky and Green rivers also discharged a large quantity of water at the same time, but no danger-line stages were reached except at Evansville, Ind., where the river was above the danger line of 35 feet from the 18th to the 26th, inclusive, with a crest stage of 40 feet on the 22d. Due warning was given of the approach of the high water, and no damage of consequence resulted beyond the flooding of some lowlands. In all, the property loss in the vicinity of Evansville was \$1500, practically all of which might have been saved had the farmers heeded the warnings. In the vicinity of Mount Vernon, Ind., corn, cattle, and hogs, to the value of \$25,000, were saved by the warnings, while at Shawneetown, Ill., the figures were much larger.

Moderately high stages in the South Atlantic States were preceded by the usual warnings, and nothing of unusual interest occurred.

The rivers of the Pacific coast changed but little, with the exception of the Willamette, which rose considerably during the first decade of the month on account of the excessive rains of that period. At Albany, Oreg., the maximum stage was 24.5 feet, 4.5 feet above the danger line, but farther down the river the rise was not so pronounced.

The highest and lowest water, mean stage, and monthly range at 156 river stations are given in Table VII. Hydrographs for typical points on seven principal rivers are shown on Chart V. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfeld, Forecast Official.*

## CLIMATE AND CROP SERVICE.

By JAMES BERRY, Chief of Climate and Crop Service Division.

The following summaries relating to the general weather and crop conditions during December are furnished by the directors of the respective sections of the Climate and Crop Service of the Weather Bureau:

**Alabama.**—First two weeks favorable for plowing. Very general and heavy to excessive rains during middle of month suspended farm work. Temperature averaged nearly normal until the night of the 25-26th, when a decided fall of temperature swept over the entire State, lasting through the 28th, giving temperatures as low as 8° in northern counties, doing no material damage to wheat and oats, which were doing well. Winter gardens in southern counties not seriously damaged. Some trucking land being prepared.—*F. P. Chaffee.*

**Arkansas.**—Frequent rains and damp weather retarded picking late maturing cotton, arrested its development, and injured the quality. Too wet for plowing or other farm work. Considerable corn in fields in north-east section; hauling and storing prevented by wet weather. Weather generally favorable for grain; the ground not frozen to any extent until the last week, when there were a few decidedly cold days. Early sown wheat and winter oats in good condition and doing well, but the weather was not favorable for sowing grain. Practically no preparations have been made for next season's crops.—*Edward B. Richards.*

**Arizona.**—The average temperature during December was slightly below normal, and the precipitation for the month was considerably in excess of the normal. The unusual amount of precipitation for November and December has been beneficial to ranges, and stock is generally doing well, ample feed being promised for the rest of the winter. Considerable grain has been sown and it is doing well. Seeding will continue during the coming month.—*M. E. Blystone.*

**California.**—The continued cold weather retarded the growth of grain and grass, but caused no material damage. Temperatures below freezing were frequent in nearly all parts of the State, but, as ample warnings were given to orange growers, the severe frosts caused but little injury to the fruit or young trees. Heavy rains in southern California were very beneficial to grain and grass. A large acreage of wheat is being sown.—*Alexander G. McAfee.*

**Colorado.**—For the mountain region as a whole the snowfall during October, November, and December has been less than normal, but as compared with the corresponding period last year there has been an excess, except on the watersheds of the Grand, White, Yampa, and North Platte. The general outlook for late irrigation, especially on the eastern and southern slopes, was much better than for several years.—*F. H. Brandenburg.*

**Florida.**—Conditions were most favorable until the middle of the third decade. On the 27th and 28th the weather became very cold, the line of freezing weather touching the northern limit of the southern district. Frost occurred over lowlands of the southern district some distance from the coast. Vegetables suffered throughout northern and central portions, and young citrus trees were slightly damaged. Some oranges in exposed places were frosted.—*A. J. Mitchell.*

**Georgia.**—The month was slightly colder than the average in north Georgia and warmer than the average in south Georgia. In the middle section nearly normal temperature prevailed. The coldest period was from the 26th to 28th, inclusive, when the minimum thermometer registered below 20° over the larger portion of the State. The general distribution of precipitation was irregular, particularly in the southern counties. The absence of extended cold weather during the month was favorable to fall sown wheat and oats, and no damage from winter killing was reported.—*J. B. Marbury.*